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Summary

The ability to successfully artificially inseminate cattle requires determining the appropriate time to inseminate. Therefore, detection of standing estrus is a major factor in the success or failure of most artificial insemination programs. The objective of these experiments was to determine the efficiency and accuracy of three estrous detection methods (visual, penile deviated bull, and Estrus Alert estrous detection aids) to determine if animals were going to ovulate. Fifty-three postpartum beef cows were synchronized with an injection of gonadotropin releasing hormone (**GnRH**) followed by an injection of prostaglandin F_2 (PG) seven days later. Estrus was monitored for 72 hours following the PG injection by visual estrus detection and Estrus Alert estrous detection aids. Thirty-seven beef heifers were synchronized with an injection of GnRH and insertion of a Controlled Internal Drug Releasing (**CIDR**) device on day 0. On day 7 an injection of PG was administered and the CIDR was removed from half the heifers on day 7 and the remaining heifers on day 14. Estrus was monitored for 5 days following CIDR removal by visual estrus detection, a penile deviated bull, and the Estrus Alert estrous detection aids. Ovulation was determined in all animals by transrectal ultrasonography between 48 and 96 hours after the onset of standing estrus. The percentage of animals detected in standing estrus and the percentage correctly identified as going to ovulate was similar ($P > 0.78$) among all three methods. In summary, intensive visual estrus detection, a marker animal, or proper use of estrous detection aids can correctly identify the majority of animals that will ovulate.

Introduction

Reproductive failure is a major factor effecting the production and economic efficiencies of dairy and beef operations (Bellows et al., 2002). Furthermore, the success of any breeding program requires detecting the animals that are ready to be bred and inseminating them at the correct time prior to ovulation. With natural service, the herd bull detects when cows should be inseminated, but when artificial insemination is used the herdsman must now decide when cows are ready to be inseminated. Therefore, failing to detect estrus and incorrect detection of estrus can result in significant economic losses (Heersche and Nebel, 1994).

Currently, detection of standing estrus is the best indicator of ovulation in cattle. Fertilization rates following natural service or artificial insemination in cattle range from 89 to 100% when ovulation occurs (Kidder et al., 1954; Bearden et al., 1956; Diskin and Sreenan, 1980; Maurer and Chenault, 1983; Gayerie de Abreu et al., 1984). Furthermore, timing of insemination plays a role in the success of any breeding program. Saacke et al., (2000) reported that when insemination occurs before the onset of standing estrus (>30 hrs before ovulation), fertilization rates are low but embryo quality is high; however, when insemination occurs >12 hours after the initiation of estrus (<18 hours before ovulation), fertilization rates are high but embryo quality is low. Therefore several aids have been developed to assist in the detection of standing estrus in cattle. The objective of these experiments were to compare the efficiency and accuracy of intensive visual estrus detection, a penile deviated bull, and the Estrus Alert estrous detection aid, to determine when animals are ready to ovulate.

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Material and Methods

Experimental Design

Postpartum multiparous (3 to 13 years old) Angus-crossed beef cows (n = 53) at the South Dakota State Uniersity Beef Breeding Unit were injected with gonadotropin releasing hormone (**GnRH**, 100 μg as 2 mL of Ovacyst i.m.; Phoenix Scientific St. Joseph, MO) on day 0, and prostaglandin $F_{2\alpha}$ (PG; 25 mg as 5 mL of Prostamate i.m., Phoenix Scientific, St. Joseph, MO) on day 7. Estrus Alert patches (Western Point, Inc. Merrifield, MN) were placed on the tailhead at the time of PG administration on day 7. Estrus was detected for 72 hours by 1) visual observation every three hours and 2) the amount of activation of an Estrus Alert estrous detection aid. All cows were examined by transrectal ultrasonography 48 to 96 hours after the onset of estrus to determine if ovulation had occurred.

Angus and Angus-cross beef heifers (n = 37) at the South Dakota State Uniersity Cow-Calf Unit were injected with GnRH (100 μg as 2 mL of Ovacyst i.m.; Phoenix Scientific St. Joseph, MO) and a Controlled Internal Drug Release (CIDR; Pfizer, New York, NY) was inserted into the vagina on day 0. Estrus Alert patches (Western Point, Inc. Merrifield, MN) were placed on the tailhead at the time of GnRH administration on day 0. On day 7 all heifers received an injection of $PGF_{2\alpha}$ (25 mg as 5 mL of Lutalyse i.m., Pfizer, New York, NY), and CIDR were removed on day 7 or 14. Estrus was detected for five days following CIDR removal by 1) visual observation three times daily for at least 30 minutes, 2) a penile deviated bull, and 3) the amount of activation of an Estrus Alert estrous detection aid. All heifers were examined by transrectal ultrasonography between 48 and 96 hours after the onset of estrus to determine if ovulation had occurred.

Determination of Standing Estrus

Animals were classified as 1) in standing estrus, 2) suspect, or 3) not in estrus. By visual detection, animals were classified as in standing estrus when they stood to be mounted by another animal and did not try to move. When animals would not stand to be mounted, but exhibited secondary signs of standing estrus (i.e. congregating, mounting other animals, clear mucus from vagina, nervous and restless, or roughed up tailhead) animals were classified as suspect, and animals that showed no signs of estrus were classified as being not in estrus. By penile deviated bull, animals were classified in standing estrus if they stood to be mounted by the bull. When animals would not stand to be mounted, but the bull continued to try to mount them, they were classified as suspect. When the bull showed no interest in the animal they were classified as not in estrus. By the Estrus Alert estrous detection aid, animals were classified in standing estrus when the patch had been completely activated (Figure 1a). When the patch was partially activated animals were classified as suspect (Figure 1b), and as not in estrus when the patch had no signs of activation (Figure 1c).

Efficiency and Accuracy

The efficiency of each estrous detection method was determined by the percentage of animals that ovulated and were detected in standing estrus (the number of animals detected in standing estrus and ovulated divided by the number of animals that ovulated multiplied by 100). The accuracy of each estrous detection method to predict ovulation was determined by the percentage of animals detected in standing estrus that did ovulate and the animals not detected in standing estrus that did not ovulate (identified correctly), and by the percentage of animals detected in standing estrus that did not ovulate and the animals not detected in standing estrus that did ovulate (identified incorrectly).

Statistical Analysis

The percentage of animals detected in standing estrus, and the percentage of cows correctly (detected in standing estrus and ovulated, not detected in estrus and did not ovulate) and incorrectly (detected in standing estrus and did not ovulate, not detected in standing estrus and did ovulate) identified by each estrous detection method were analyzed using categorical data modeling in SAS (Proc Catmod). The preceding variables were analyzed for an effect of treatment.

Results

The number of animals that ovulated, as determined by transrectal ultrasonography are shown in Table 1. Seventy-four animals ovulated following estrus synchronization (37 cows and 37 heifers). The number of animals detected in standing estrus, suspect, or not in standing estrus by visual observation, by the penile deviated bull, and by the Estrus Alert estrus detection aids, are shown in Table 1. There was no difference (*P > 0.65*) in the efficiency of estrous detection among the three estrous detection methods (91%, 92%, and 89% for visual observation, penile deviated bull, and Estrus Alert patches; respectively).

Of the 53 postpartum beef cows, one cow ovulated but was never detected in standing estrus by either visual observation or the Estrus Alert patches. However, two cows were detected in standing estrus by both visual observation and the Estrus Alert patches but did not ovulate. Among the 37 heifers two heifers ovulated but were never detected in standing estrus by visual observation, a penile deviated bull, or the Estrus Alert patches. One heifer was detected in standing estrus by visual observation and the penile deviated bull and did ovulate, but was not detected in standing estrus by the Estrus Alert patches.

The percentage of animals identified correctly by each of the three estrous detection methods did not differ (*P* > 0.79). The percentage of cows correctly determined to be in standing estrus and going to ovulate also did not differ (*P > 0.31*) among estrous detection methods (Table 2). A similar (*P > 0.87)* number of animals were determined to be suspect by intensive visual observation, a penile deviated bull, and by the Estrus Alert patches (2, 1, and 2, respectively).

Discussion

Detection of standing estrus can be one of the time consuming herd management chores related to estrous synchronization and artificial insemination. However, the success of any breeding program requires detecting the animals that are ready to be bred and inseminating them at the correct time prior to ovulation. Therefore, failing to detect estrus and incorrect detection of estrus can result in significant economic losses (Heersche and Nebel, 1994). Furthermore, using continuous monitoring of over 500 animals exhibiting natural estrus in 3 separate studies indicated that greater than 55% of cows initiated standing estrus from 6 p.m. to 6 a.m. (Hurnik and King, 1987; Xu et al., 1998; Perry unpublished data). The efficiency of each of the methods of estrous detection tested was 89% or greater. Indicating that each of the methods used can very effectively determine which animals have been or are in standing estrus even when visual observation is difficult. These efficiencies are very similar to efficiencies reported for grazing dairy cows (visual with tail paint 98% and the HeatWatch electronic estrous detection system 91%) over a 6 week breeding season (Xu et al., 1998).

In both the heifer and cow groups there were animals that ovulated without being detected in standing estrus. Similar results have been reported in peripubertal heifers where 7% and 25% of heifers had a silent or nonstanding estrus, respectively (Morrow et al., 1976). Following treatment with a CIDR or MGA along to induce estrous cycles in anestrous cows 25% and 43% of cows ovulated without exhibiting signs of standing estrus, respectively (Perry et al., 2004). Furthermore, detection of standing estrus prior to the first postpartum ovulation has ranged from 20% to 50% depending on the frequency of estrus detection (see review by Wettemann, 1980).

In the present study there was no difference in the accuracy of three estrous detection methods used and all were greater than 90%. Inseminating animals detected in estrus with any of these methods would result in the majority of the animals getting inseminated around the time of ovulation. Furthermore, similar pregnancy rates have been reported for once daily insemination and twice daily insemination when animals have been detected in standing estrus (Nebel et al., 1994; Graves et al., 1997). However, the timing of insemination after the onset of standing estrus can influence fertilization rates and embryo quality (Dalton et al., 2001). When insemination occurs before the onset of standing estrus (>30 hrs before ovulation), fertilization rates are low but embryo quality is high; however, when insemination occurs >12 hours after the initiation of estrus (<18 hours before ovulation), fertilization rates are high but embryo quality is low (Saacke et al., 2000). Inseminating cattle approximately 12 hours after the onset of standing estrus should result in the best fertility with good fertilization rates and good embryo quality (Saacke et al., 2000; Dalton et al., 2001).

Implications

Detection of standing estrus can be one of the most time-consuming chores related to estrous synchronization and artificial insemination. However, the success of any artificial insemination program requires detecting the animals that are ready to be bred (standing estrus) and inseminating them at the correct time. Several estrous detection aids have been developed to assist with this time consuming chore. These estrus detection aids can very effectively determine which cows are or have been in standing estrus, therefore relieving the time required to visually observe cattle for standing estrus. However, increased visual observation in addition to the use of estrous detection aids could improve fertility by detecting the most possible number of animals ready to be inseminated and indicating the most appropriate time for insemination.

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Tables

Table 1. Number of animals detected in standing estrus, suspect, or not in standing estrus by visual observation, a penile deviated bull, or the Estrus Alert patch

	Visual	Penile Deviated Bull	Estrus Alert
Standing Estrus (cows;heifers)[a]	69 (35;34)	34 (0; 34)	68 (35;33)
Suspect (cows;heifers)[b]	2 (0;2)	1 (0;1)	2 (0;2)
Not in standing estrus (cows;heifers)[c]	19 (17;2)	2 (0;2)	20 (17;3)
Ovulated (cows;heifers)[d]	74 (37;37)	37 (0;37)	74 (37;37)
Efficiency[e]	91% (67/74)	92% (34/37)	89% (66/74)

[a]Number of animals determined to be in standing estrus by each estrous detection method.
[b]Number of animals that indicated signs of standing estrus but did not fully meet the requirements of standing estrus.
[c]Number of animals determined to not be in standing estrus by each estrous detection method.
[d]Number of animals that each method was used on that actually ovulated as determined by transrectal ultrasonography.
[d]The number of animals detected in standing estrus and ovulated divided by the number of animals that ovulated multiplied by 100.

Table 2. The accuracy of visual estrous detection, a penile deviated bull, and the Estrus Alert estrus detection aid

	Visual	Penile Deviated Bull	Estrus Alert
Percent identified correctly[a]	92% (83/90)	92% (34/37)	91% (82/90)
Percent identified incorrectly[b]	8% (7/90)	8% (3/37)	9% (8/90)
Percent suspect[c]	2% (2/90)	3% (1/37)	2% (2/90)
Percent identified in standing estrus that ovulated[d]	97% (67/69)	100% (34/34)	97% (66/68)
Percent identified in standing estrus that ovulated (including suspect animals)[e]	97% (69/71)	100% (35/35)	97% (68/70)

[a]The number of animals detected in standing estrus and ovulated plus the number of animals determined not to be in standing estrus and not ovulating divided by the total number of animals X 100.
[b]The number of animals detected in standing estrus and did not ovulated plus the number of animals determined not to be in standing estrus and did ovulate divided by the total number of animals X 100.
[c]The number of animals that indicated signs of standing estrus but did not fully meet the requirements of standing estrus divided by the total number of animals X 100.
[d]The number of animals detected in standing estrus and ovulated divided by the total number of animals detected in standing estrus X 100.
[e]The number of animals detected in standing estrus or suspect and ovulated divided by the total number of animals detected in standing estrus and suspect X 100.

A

B

C

Figure 1. Examples of an Estrus Alert patch on an animal that was in standing estrus (A), a patch on an animal classified as suspect (B), and a patch on an animal classified as not in standing estrus.